# ONLINE LARGE-SCALE ASSESSMENT OF DIVERGENT THINKING AND ITS RELATION TO MATHEMATICAL ACHIEVEMENT

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Divergent thinking is one of the most researched thinking processes behind creative performance (*Runco* & *Acar*, 2012) and also plays significant role in mathematical creativity (*Nadjafikhah* & *Yaftian*, 2013). However, in order to enhance creativity, assessment tools are necessary for setting standards and to measure students' progress. As printing, distributing and particularly evaluating creativity tests are the most expensive components of large-scale assessments and routine use, online delivery may represent a major step towards making creativity assessment more affordable. The aim of this study is twofold: (1) to develop an online assessment tool for divergent thinking which can also be used in large-scale assessments and (2) to explore the relationship between divergent thinking and different dimensions of mathematical achievement. The participants were 1,984 sixth grade students. The online instrument was based on *Torrance* (1966) and *Wallach* and *Kogan* (1965) item types for divergent thinking. It consisted of three alternative uses and three instances (verbal subtests) and three picture meaning tasks (figural subtest). Widely used measures of divergent thinking were applied for scoring answers: fluency, flexibility and originality. Since the instrument was newly developed, there was no database or test manual to score the answers. Therefore, with the participation of independent raters, all answers were categorized manually and decisions were made about questionable answers with regard to their relevance. After this process, a separate software calculated the three indices automatically. An online test was also developed to assess different dimensions of mathematical knowledge (content knowledge, thinking and application). The reliability of the test was Cronbach's alpha=.91. Data collection was carried out via the eDia platform. The Cronbach's alpha indexes of the divergent thinking instrument were .92 for fluency, .89 for flexibility and .90 for originality. The three-dimensional model (fluency, flexibility and originality) fit the data better than the one-dimensional model (Chi-square=972.54, df=3 p<.001). Further empirical evidence for construct validity is supported by the correlation patterns between verbal and figural subtests. Divergent thinking explained performance in all three dimensions of mathematics with a similar effect (factor loadings ranged between .36 and .40). The advantages of technology made our tool suitable for large-scale assessment: automated data collection and scoring reduced the time and cost of the testing process. However, further research is necessary to make the coding fully automated in order to provide immediate feedback after test completion. Our finding supports the claim that creativity plays an important role in various aspects of mathematical performance, however, the values were not too high. It would be worth examining if relationships with other domains (e.g. science, reading) are also at about the same level.

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